

REMARKS

INTRODUCTION

The Applicant herein withdraws the pending Appeal that is in front of the US Patent & Trademark Office Appeals Board. A separate statement will be filed with the Appeals Board to provide them with sufficient notice.

ISSUE NO. 1 - §102(B) REJECTION OF CLAIMS 1-10 AND 13-24 BASED ON GB-A-2274 109

Claims 1-10 and 13-24 are rejected under 35 USC §102(b) as being anticipated by GB-A-2274 109 ("T & N"). The Applicant respectfully disagrees.

Claim 1 recites: "A pre-fiber gel composition, comprising: at least one amide-based polymer; and at least 15 weight percent of at least one lactam gelling agent, wherein **the gel composition** has sufficient viscosity and sufficient cohesiveness upon the mixing of the at least one amide-based polymer and the at least one lactam gelling agent that the composition can be spun into a fiber." (emphasis added)

Claim 13 recites: "A method of producing a pre-fiber gel composition, comprising: providing at least one amide-based compound; providing at least 15 weight percent of at least one lactam gelling agent; and mixing the at least one amide-based polymer and the at least one lactam gelling agent such that there is **sufficient viscosity and sufficient cohesiveness in the composition** so that it can be spun into a fiber." (emphasis added)

While the concept of gel compositions for forming fibers can be straightforward, successful implementation can be more difficult. The solvent-polymer system must achieve a gel that has sufficient solvation of the polymer molecules to manipulate the microstructure while still having sufficient melt strength to be processed into useful shapes. Once the article has been made, the solvent is typically removed to bring the polymer to its

full properties. Solvent removal and recovery presents numerous cost and equipment issues to extract and dry the polymer and then recycle or otherwise dispose of the spent solvents. Industrial hygiene and environmental issues further complicate implementation. It is understandable why this technology has been limited to very high value materials like ballistic fibers.

For example, there is no recognized solvent system for gel processing of polyamide 6 (also known as nylon-6 or poly-caprolactam). Standard solvents like formic acid yield a solution far too low in viscosity for processing. Further, if nylon-6 gel processed products are to compete in applications other than high-cost ballistic fibers, a suitable solvent that is low-cost to implement is required. One candidate for gel processing nylon-6 products that has not been investigated is the epsilon-caprolactam monomer used to make nylon-6.

Caprolactam and nylon compounds have each been individually polymerized with the same compounds (i.e. caprolactam/caprolactam or nylon/nylon) by anionic polymerization in a twin-screw extruder and then tested for residual monomer content and thermal/mechanical properties. In both methods, however, the polymerization process used was not designed to and did not result in a pre-fiber gel composition that could be processed by any means (including extrusion), and there was no indication that the mechanical strength or thermal strength was improved by the single monomer/twin-screw extruder mixing process. (see Antec '93 Conference Proceedings, New Orleans, 9th-13th May 1993, Vol. 1, p. 470-473; and Antec '94 Conference Proceedings, San Francisco, CA, 1st-5th May 1994, Vol. 1, p. 116-22)

It was also known that caprolactam formed solutions with nylon-6, but these solutions took the form of residual, unpolymerized monomer found in the polymer. Typically nylon-6 resin is leached to remove this residual monomer. Deliberate addition of caprolactam for gel processing has not been previously considered. Gel processing and gel compositions are important because polymer parts have a practical limit in cross-section size due to the difficulty in forming such large cross-sections via melt processing. From a practical perspective, machines (extruders) to form polymer into shapes and sizes routinely available in metal simply do not exist. The other real limitation is that as melted

polymer cools, significant shrinkage occurs. One can often find puckers on molded parts from shrink. To an extent, shrink can be compensated with clever mold design and tuning the molding process.

The formation of a pre-fiber gel composition and/or material allows for the control of the properties of the drawn fiber by allowing for more favorable orientation of the polymer molecules in the fiber. Controlling the molecule orientation can lead to increased tensile strength and overall fiber durability. Furthermore, at least part of the at least one gelling agent (such as a lactam gelling agent) can be removed and recovered from the spun fiber once formed. In addition, any unpolymerized monomers can be subsequently polymerized after further processing to create properties in the spun fiber that are difficult or impossible to achieve with conventional spun polymers. This polymerization technique is described in commonly owned US Provisional Application entitled "Pre-Composite and Composite Materials, Methods of Manufacture and Uses Thereof" (Serial No. not yet assigned) that has been filed concurrently and is incorporated herein in its entirety by reference.

In T & N, a molding composition that contains nylon and magnesium hydroxide has caprolactam added to it to reduce the formation of surface defects. There is absolutely no teaching in T & N that the caprolactam addition to the mixture of nylon and magnesium hydroxide results in the formation of a gel composition. The Examiner contends in the Examiner's answer that "because the components and processing equipment of the patented invention are essentially the same as those of appellant claims, the formation of a gel is inherent". The Examiner is again overbroadening the applicability of the T&N patent to this application, and the Applicant respectfully requests that the Examiner review this response in view of T&N again in order to reopen prosecution.

In T&N, the applicants mix nylon, caprolactam, water, calcium stearate, glass fibers (as a reinforcement) and magnesium hydroxide. Note that in both examples, over 50% magnesium hydroxide is added – which is a significant chemical component, as compared to nylon and caprolactam. Also, it is instructive to note the presence of glass fibers in the mixture. These are not the same components as disclosed in the present application. In addition, despite the fact that the current independent claims uses "comprising" language,

it is fairly clear that the materials used in T&N will not form gel compositions – and therefore, they will not anticipate claim 1 and claim 13, which require that a gel composition be formed. In addition, given the high loading of the hydroxide and glass fibers in the T&N materials, it is quite unclear whether a gel would be formed at all and whether any advantage disclosed regarding the current compositions would be realized at all in T&N's system. Certainly it can be said that a skilled worker in fiber spinning would not look to T&N as the high non-polymer loading would be most likely unspinnable. Certainly one could not pass glass fiber filler through the very narrow orifice for a filament.

There are significant clues in T&N that show it is not disclosing gel compositions, such as those claimed in the present application. First, the components in T&N are heated to a temperature of 260°C while being screw extruded at a high RPM (250 RPM). In the current application, the materials and compositions produced in the present application are designed to be produced at or below normal processing temperatures (see page 3 and Example 2) – an option that is not available in the T&N reference. The key reason why the T&N materials are “easy to extrude” is that they are being processed at high temperatures with high rotation rates of the extruder. That difference is what makes the current application special – gel compositions and fibers can be formed at lower temperatures with less effort.

Claim 1 and 13 states that “**the gel composition** has sufficient viscosity and sufficient cohesiveness **upon the mixing** of the at least one amide-based polymer and the at least one lactam gelling agent that the composition can be spun into a fiber”. In T&N, the material cannot be spun into a fiber until it is heated and extruded. In Example 2 of the current application, the inventors note “Furthermore, it was observed that extruder temperature could be dropped below conventional conditions for neat polymers, given that the gel compositions allowed for lower extruder pressures.” The Extruder temperature in T&N has not been dropped below that of conventional processes, again indicating that a gel composition has not been formed.

Second, the inclusion of about 10% of glass fibers for reinforcement purposes in the T&N reference is also troubling, given that the processing steps taken in the present

application result in fibers and fiber products that are strengthened by the process and not by additional reinforcement additives.

Although the Examiner considers the fact that both references include the components of nylon and caprolactam in the final material – the Applicants believe it is unreasonable for the Examiner to consider them both implicitly identical given the large weight percent of other components in the T&N patent. Consider that the weight percent of all of the other components – other than the nylon and caprolactam – in the T&N patent outweigh the weight percent of nylon and caprolactam. Surely, the Examiner is considering that the large weight percent of these components must influence the chemical nature of the final material.

Formation of the gel composition is very important and central to the present application, because of all of the benefits of utilizing a gel composition mentioned herein. Fibers formed from these new gel compositions have superior strength and tensile properties because of the ability to spin the gel at high speeds, which suggests that nylon gel products can be manufactured with productivity comparable to melt processing. The excellent melt strength of the gels also allow the polymer to be highly shaped or drawn prior to solvent removal; or, only lightly processed, the caprolactam removed, and then post-processed to achieved the desired combination of properties.

In addition, claims 1 and 13 contain the provision that the at least one lactam gelling agent is present in at least 15 weight percent. The Examiner cannot possibly contend that the amount of caprolactam in T&N is greater than 10 weight percent based on the disclosure.

T & N does not teach all of the claimed elements of the present application. “Anticipation requires the disclosure in a single prior art reference of each element of the claim under consideration.” *W. L. Gore & Assocs. v. Garlock, Inc.*, 721 F.2d 1540, 220 USPQ 303, 313 (Fed. Cir. 1983) (citing *Soundsciber Corp. v. United States*, 360 F.2d 954, 148 USPQ 298, 301 (Ct. Cl.), *adopted*, 149 USPQ 640 (Ct. Cl. 1966)) Further, the prior art reference must disclose each element of the claimed invention “**arranged as in**

the claim". *Lindermann Maschinenfabrik GmbH v. American Hoist & Derrick Co.*, 730 F.2d 1452, 221 USPQ 481, 485 (Fed. Cir. 1984)(citing *Connell v. Sears, Roebuck & Co.*, 722 F.2d 1542, 220 USPQ 193 (Fed. Cir. 1983)). T & N does not teach a combination of an amide and a lactam gelling agent that will form a gel composition, such as those described in the present application. Based on this argument, along with others such as that discussed above, T & N does not anticipate claims 1 and 13 of the present application because T & N is lacking and/or missing at least one specific feature or structural recitation found in the present application, and in claims 1 and 13. Claims 1 and 13 are therefore allowable as not being anticipated by T & N. Further, T & N does not anticipate claims 2-10 and 14-24 of the present application by virtue of their dependency on claims 1 and 13 respectively.

ISSUE NO. 2 - §102(B) REJECTION OF CLAIMS 1-11, 13-25 AND 27 BASED ON US 5047459

Claims 1-11, 13-25 and 27 are rejected under 35 USC §102(b) as being anticipated by US 5,047,459 (“Walde”). The Applicant respectfully disagrees.

Claim 1 recites: “A pre-fiber gel composition, comprising: at least one amide-based polymer; and at least 15 weight percent of at least one lactam gelling agent, wherein **the gel composition** has sufficient viscosity and sufficient cohesiveness upon the mixing of the at least one amide-based polymer and the at least one lactam gelling agent that the composition can be spun into a fiber.” (emphasis added)

Claim 13 recites: “A method of producing a pre-fiber gel composition, comprising: providing at least one amide-based compound; providing at least 15 weight percent of at least one lactam gelling agent; and mixing the at least one amide-based polymer and the at least one lactam gelling agent such that there is **sufficient viscosity and sufficient cohesiveness in the composition** so that it can be spun into a fiber.” (emphasis added)

While the concept of gel compositions for forming fibers can be straightforward, successful implementation can be more difficult. The solvent-polymer system must achieve a gel that has sufficient solvation of the polymer molecules to manipulate the microstructure while still having sufficient melt strength to be processed into useful shapes. Once the article has been made, the solvent is typically removed to bring the polymer to its full properties. Solvent removal and recovery presents numerous cost and equipment issues to extract and dry the polymer and then recycle or otherwise dispose of the spent solvents. Industrial hygiene and environmental issues further complicate implementation. It is understandable why this technology has been limited to very high value materials like ballistic fibers.

For example, there is no recognized solvent system for gel processing of polyamide 6 (also known as nylon-6 or poly-caprolactam). Standard solvents like formic acid yield a solution far too low in viscosity for processing. Further, if nylon-6 gel processed products are to compete in applications other than high-cost ballistic fibers, a suitable solvent that is

low-cost to implement is required. One candidate for gel processing nylon-6 products that has not been investigated is the epsilon-caprolactam monomer used to make nylon-6.

Caprolactam and nylon compounds have each been individually polymerized with the same compounds (i.e. caprolactam/caprolactam or nylon/nylon) by anionic polymerization in a twin-screw extruder and then tested for residual monomer content and thermal/mechanical properties. In both methods, however, the polymerization process used was not designed to and did not result in a pre-fiber gel composition that could be processed by any means (including extrusion), and there was no indication that the mechanical strength or thermal strength was improved by the single monomer/twin-screw extruder mixing process. (see Antec '93 Conference Proceedings, New Orleans, 9th-13th May 1993, Vol. 1, p. 470-473; and Antec '94 Conference Proceedings, San Francisco, CA, 1st-5th May 1994, Vol. 1, p. 116-22)

It was also known that caprolactam formed solutions with nylon-6, but these solutions took the form of residual, unpolymerized monomer found in the polymer. Typically nylon-6 resin is leached to remove this residual monomer. Deliberate addition of caprolactam for gel processing has not been previously considered. Gel processing and gel compositions are important because polymer parts have a practical limit in cross-section size due to the difficulty in forming such large cross-sections via melt processing. From a practical perspective, machines (extruders) to form polymer into shapes and sizes routinely available in metal simply do not exist. The other real limitation is that as melted polymer cools, significant shrinkage occurs. One can often find puckers on molded parts from shrink. To an extent, shrink can be compensated with clever mold design and tuning the molding process.

The formation of a pre-fiber gel composition and/or material allows for the control of the properties of the drawn fiber by allowing for more favorable orientation of the polymer molecules in the fiber. Controlling the molecule orientation can lead to increased tensile strength and overall fiber durability. Furthermore, at least part of the at least one gelling agent (such as a lactam gelling agent) can be removed and recovered from the spun fiber once formed. In addition, any unpolymerized monomers can be subsequently polymerized

after further processing to create properties in the spun fiber that are difficult or impossible to achieve with conventional spun polymers. This polymerization technique is described in commonly owned US Provisional Application entitled "Pre-Composite and Composite Materials, Methods of Manufacture and Uses Thereof" (Serial No. not yet assigned) that has been filed concurrently and is incorporated herein in its entirety by reference.

In Walde, thermoplastic materials and thermoplastic polycondensation products are described that contain flame retardants and lactams mixed with adducted melamines. The products are then melt processed and the solid formations are ground into powders. There is absolutely no teaching in Walde that the lactam addition to the thermoplastic materials or thermoplastic condensation products results in the formation of a gel composition. The Examiner is again overbroadening the applicability of the Walde patent to this application. In Walde, the applicants mix polyamides, polyesters and flame retardants together to form a mixture which is extruded to form various fibers.

In Walde, there is a lactam-isocyanate adduct included in the materials, which is not presented as or contemplated as a lactam gelling agent. It is unreasonable to assume that an adduct that happens to have a lactam as part of the adduct will perform the same as the lactam gelling agent disclosed in the present application. Despite what the Examiner contends – **the components are not the same**.

The Examiner should point out how the addition of a lactam gelling agent will result in gelling the polyesters, along with the polyamides and flame retardants. Although the Examiner considers the fact that both references include the components of polyamide and caprolactam in the final material – the Applicants believe it is unreasonable for the Examiner to consider them both implicitly identical given the large weight percent of other components in the Walde patent. Consider that the weight percent of all of the other components – other than the nylon and caprolactam – in the Walde patent can outweigh the weight percent of polyamide and caprolactam. Surely, the Examiner is considering that the large weight percent of these components must influence the chemical nature of the final material. In addition, the Walde patent is similar to the T&N patent – in that both state that reinforcing additives can be added to strengthen the fibers and materials produced

from their processes. Again, this point is one that shouldn't be overlooked in the present application – and that is that the current process can result in stronger fibers and fiber materials without the addition of additional reinforcing materials.

Formation of the gel composition is very important and central to the present application, because of all of the benefits of utilizing a gel composition mentioned herein. Fibers formed from these new gel compositions have superior strength and tensile properties because of the ability to spin the gel at high speeds, which suggests that nylon gel products can be manufactured with productivity comparable to melt processing. The excellent melt strength of the gels also allow the polymer to be highly shaped or drawn prior to solvent removal; or, only lightly processed, the caprolactam removed, and then post-processed to achieved the desired combination of properties.

In addition, the Examiner cannot possibly contend that the amount of lactam (outside of the isocyanate-lactam adduct) in Walde is greater than 10 weight percent based on the disclosure.

Walde does not teach all of the claimed elements of the present application. “Anticipation requires the disclosure in a single prior art reference of each element of the claim under consideration.” *W. L. Gore & Assocs. v. Garlock, Inc.*, 721 F.2d 1540, 220 USPQ 303, 313 (Fed. Cir. 1983) (citing *Soundsciber Corp. v. United States*, 360 F.2d 954, 148 USPQ 298, 301 (Ct. Cl.), *adopted*, 149 USPQ 640 (Ct. Cl. 1966)) Further, the prior art reference must disclose each element of the claimed invention “**arranged as in the claim**”. *Lindermann Maschinenfabrik GmbH v. American Hoist & Derrick Co.*, 730 F.2d 1452, 221 USPQ 481, 485 (Fed. Cir. 1984)(citing *Connell v. Sears, Roebuck & Co.*, 722 F.2d 1542, 220 USPQ 193 (Fed. Cir. 1983)). Walde does not teach a combination of an amide and a lactam gelling agent that will form a gel composition, such as those described in the present application. Based on this argument, along with others such as that discussed above, Walde does not anticipate claims 1 and 13 of the present application because Walde is lacking and/or missing at least one specific feature or structural recitation found in the present application, and in claims 1 and 13. Claims 1 and 13 are therefore allowable as not being anticipated by Walde. Further, Walde does not anticipate

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claims 2-11, 14, 25 and 27 of the present application by virtue of their dependency on claims 1 and 13 respectively.

ISSUE NO. 3 - §102(B) REJECTION OF CLAIMS 1-4, 11, 13-16, 22-25 AND 27 BASED ON US 4745143

Claims 1-4, 11, 13-16, 22-25 and 27 are rejected under 35 USC §102(b) as being anticipated by US 4,745,143 ("Mason"). The Applicant respectfully disagrees.

Claim 1 recites: "A pre-fiber gel composition, comprising: at least one amide-based polymer; and at 15 weight percent of at least one lactam gelling agent, wherein the gel composition has sufficient viscosity and sufficient cohesiveness upon the mixing of the at least one amide-based polymer and the at least one lactam gelling agent that the composition can be spun into a fiber."

Claim 13 recites: "A method of producing a pre-fiber gel composition, comprising: providing at least 15 weight percent of at least one amide-based compound; providing at least one lactam gelling agent; and mixing the at least one amide-based polymer and the at least one lactam gelling agent such that there is sufficient viscosity and sufficient cohesiveness in the composition so that it can be spun into a fiber."

While the concept of gel compositions for forming fibers can be straightforward, successful implementation can be more difficult. The solvent-polymer system must achieve a gel that has sufficient solvation of the polymer molecules to manipulate the microstructure while still having sufficient melt strength to be processed into useful shapes. Once the article has been made, the solvent is typically removed to bring the polymer to its full properties. Solvent removal and recovery presents numerous cost and equipment issues to extract and dry the polymer and then recycle or otherwise dispose of the spent solvents. Industrial hygiene and environmental issues further complicate implementation. It is understandable why this technology has been limited to very high value materials like ballistic fibers.

For example, there is no recognized solvent system for gel processing of polyamide 6 (also known as nylon-6 or poly-caprolactam). Standard solvents like formic acid yield a

solution far too low in viscosity for processing. Further, if nylon-6 gel processed products are to compete in applications other than high-cost ballistic fibers, a suitable solvent that is low-cost to implement is required. One candidate for gel processing nylon-6 products that has not been investigated is the epsilon-caprolactam monomer used to make nylon-6.

Caprolactam and nylon compounds have each been individually polymerized with the same compounds (i.e. caprolactam/caprolactam or nylon/nylon) by anionic polymerization in a twin-screw extruder and then tested for residual monomer content and thermal/mechanical properties. In both methods, however, the polymerization process used was not designed to and did not result in a pre-fiber gel composition that could be processed by any means (including extrusion), and there was no indication that the mechanical strength or thermal strength was improved by the single monomer/twin-screw extruder mixing process. (see Antec '93 Conference Proceedings, New Orleans, 9th-13th May 1993, Vol. 1, p. 470-473; and Antec '94 Conference Proceedings, San Francisco, CA, 1st-5th May 1994, Vol. 1, p. 116-22)

It was also known that caprolactam formed solutions with nylon-6, but these solutions took the form of residual, unpolymerized monomer found in the polymer. Typically nylon-6 resin is leached to remove this residual monomer. Deliberate addition of caprolactam for gel processing has not been previously considered. Gel processing and gel compositions are important because polymer parts have a practical limit in cross-section size due to the difficulty in forming such large cross-sections via melt processing. From a practical perspective, machines (extruders) to form polymer into shapes and sizes routinely available in metal simply do not exist. The other real limitation is that as melted polymer cools, significant shrinkage occurs. One can often find puckers on molded parts from shrink. To an extent, shrink can be compensated with clever mold design and tuning the molding process.

The formation of a pre-fiber gel composition and/or material allows for the control of the properties of the drawn fiber by allowing for more favorable orientation of the polymer molecules in the fiber. Controlling the molecule orientation can lead to increased tensile strength and overall fiber durability. Furthermore, at least part of the at least one gelling

agent (such as a lactam gelling agent) can be removed and recovered from the spun fiber once formed. In addition, any unpolymerized monomers can be subsequently polymerized after further processing to create properties in the spun fiber that are difficult or impossible to achieve with conventional spun polymers. This polymerization technique is described in commonly owned US Provisional Application entitled "Pre-Composite and Composite Materials, Methods of Manufacture and Uses Thereof" (Serial No. not yet assigned) that has been filed concurrently and is incorporated herein in its entirety by reference.

In Mason, plasticizers are added to polyamides to improve flexibility of the polyamide. There is absolutely no teaching in Mason that the plasticizer addition to the polyamides results in the formation of a gel composition. As a matter of fact, in Column 4, lines 48-52, it is stated that **the plasticizer can leach out of the polyamide leaving voids behind that can be filled with the salt compositions that are later added.** This description indicates that there cannot be a gel composition formed, because a gel composition would not leach the plasticizer and leave behind voids.

Formation of the gel composition is very important and central to the present application, because of all of the benefits of utilizing a gel composition mentioned herein. Fibers formed from these new gel compositions have superior strength and tensile properties because of the ability to spin the gel at high speeds, which suggests that nylon gel products can be manufactured with productivity comparable to melt processing. The excellent melt strength of the gels also allow the polymer to be highly shaped or drawn prior to solvent removal; or, only lightly processed, the caprolactam removed, and then post-processed to achieved the desired combination of properties.

Mason does not teach all of the claimed elements of the present application. "Anticipation requires the disclosure in a single prior art reference of each element of the claim under consideration." W. L. Gore & Assocs. v. Garlock, Inc., 721 F.2d 1540, 220 USPQ 303, 313 (Fed. Cir. 1983) (citing Soundsciber Corp. v. United States, 360 F.2d 954, 148 USPQ 298, 301 (Ct. Cl.), adopted, 149 USPQ 640 (Ct. Cl. 1966)) Further, the prior art reference must disclose each element of the claimed invention "arranged as in the claim". Lindermann Maschinenfabrik GmbH v. American Hoist & Derrick Co., 730 F.2d

1452, 221 USPQ 481, 485 (Fed. Cir. 1984)(citing *Connell v. Sears, Roebuck & Co.*, 722 F.2d 1542, 220 USPQ 193 (Fed. Cir. 1983)). Mason does not teach a combination of an amide and a lactam gelling agent that will form a gel composition, such as those described in the present application. Based on this argument, along with others such as that discussed above, Mason does not anticipate claims 1 and 13 of the present application because Mason is lacking and/or missing at least one specific feature or structural recitation found in the present application, and in claims 1 and 13. Claims 1 and 13 are therefore allowable as not being anticipated by Mason. Further, Mason does not anticipate claims 2-4, 11, 14-16, 22-25 and 27 of the present application by virtue of their dependency on claims 1 and 13 respectively.

ISSUE NO. 4 - §102(B) REJECTION OF CLAIMS 1, 2, 4-14, 16-24, 27 AND 28 BASED ON US 5223196

Claims 1, 2, 4-14, 16-24, 27 and 28 are rejected under 35 USC §102(b) as being anticipated by US 5223196 ("Shridharani"). The Applicant respectfully disagrees.

Claim 1 recites: "A pre-fiber gel composition, comprising: at least one amide-based polymer; and at least 15 weight percent of at least one lactam gelling agent, wherein **the gel composition** has sufficient viscosity and sufficient cohesiveness upon the mixing of the at least one amide-based polymer and the at least one lactam gelling agent that the composition can be spun into a fiber." (emphasis added)

Claim 13 recites: "A method of producing a pre-fiber gel composition, comprising: providing at least one amide-based compound; providing at least 15 weight percent of at least one lactam gelling agent; and mixing the at least one amide-based polymer and the at least one lactam gelling agent such that there is **sufficient viscosity and sufficient cohesiveness in the composition** so that it can be spun into a fiber." (emphasis added)

While the concept of gel compositions for forming fibers can be straightforward, successful implementation can be more difficult. The solvent-polymer system must achieve a gel that has sufficient solvation of the polymer molecules to manipulate the microstructure while still having sufficient melt strength to be processed into useful shapes. Once the article has been made, the solvent is typically removed to bring the polymer to its full properties. Solvent removal and recovery presents numerous cost and equipment issues to extract and dry the polymer and then recycle or otherwise dispose of the spent solvents. Industrial hygiene and environmental issues further complicate implementation. It is understandable why this technology has been limited to very high value materials like ballistic fibers.

For example, there is no recognized solvent system for gel processing of polyamide 6 (also known as nylon-6 or poly-caprolactam). Standard solvents like formic acid yield a solution far too low in viscosity for processing. Further, if nylon-6 gel processed products are to compete in applications other than high-cost ballistic fibers, a suitable solvent that is

low-cost to implement is required. One candidate for gel processing nylon-6 products that has not been investigated is the epsilon-caprolactam monomer used to make nylon-6.

Caprolactam and nylon compounds have each been individually polymerized with the same compounds (i.e. caprolactam/caprolactam or nylon/nylon) by anionic polymerization in a twin-screw extruder and then tested for residual monomer content and thermal/mechanical properties. In both methods, however, the polymerization process used was not designed to and did not result in a pre-fiber gel composition that could be processed by any means (including extrusion), and there was no indication that the mechanical strength or thermal strength was improved by the single monomer/twin-screw extruder mixing process. (see Antec '93 Conference Proceedings, New Orleans, 9th-13th May 1993, Vol. 1, p. 470-473; and Antec '94 Conference Proceedings, San Francisco, CA, 1st-5th May 1994, Vol. 1, p. 116-22)

It was also known that caprolactam formed solutions with nylon-6, but these solutions took the form of residual, unpolymerized monomer found in the polymer. Typically nylon-6 resin is leached to remove this residual monomer. Deliberate addition of caprolactam for gel processing has not been previously considered. Gel processing and gel compositions are important because polymer parts have a practical limit in cross-section size due to the difficulty in forming such large cross-sections via melt processing. From a practical perspective, machines (extruders) to form polymer into shapes and sizes routinely available in metal simply do not exist. The other real limitation is that as melted polymer cools, significant shrinkage occurs. One can often find puckers on molded parts from shrink. To an extent, shrink can be compensated with clever mold design and tuning the molding process.

The formation of a pre-fiber gel composition and/or material allows for the control of the properties of the drawn fiber by allowing for more favorable orientation of the polymer molecules in the fiber. Controlling the molecule orientation can lead to increased tensile strength and overall fiber durability. Furthermore, at least part of the at least one gelling agent (such as a lactam gelling agent) can be removed and recovered from the spun fiber once formed. In addition, any unpolymerized monomers can be subsequently polymerized

after further processing to create properties in the spun fiber that are difficult or impossible to achieve with conventional spun polymers. This polymerization technique is described in commonly owned US Provisional Application entitled "Pre-Composite and Composite Materials, Methods of Manufacture and Uses Thereof" (Serial No. not yet assigned) that has been filed concurrently and is incorporated herein in its entirety by reference.

In Shridharani, a pigmented hexamethylene adipamide fiber is melt-spun from a melt blend of a polymer and a colored pigment. The Background section of the present application clearly points out that melt processing is undesirable and that the compositions contemplated in the current application **do not need to be melt processed because of the formation of a gel composition**. The disclosure of the present application makes it very clear that formation of the gel composition and gel processing is an alternative to melt blending and melt spinning. Therefore, Shridharani provides the conventional method of processing these types of materials. In addition, Shridharani makes it quite clear that the materials produced in the patent are completely different than the ones in the current application, based on the required processing steps.

Formation of the gel composition is very important and central to the present application, because of all of the benefits of utilizing a gel composition mentioned herein. Fibers formed from these new gel compositions have superior strength and tensile properties because of the ability to spin the gel at high speeds, which suggests that nylon gel products can be manufactured with productivity comparable to melt processing. The excellent melt strength of the gels also allow the polymer to be highly shaped or drawn prior to solvent removal; or, only lightly processed, the caprolactam removed, and then post-processed to achieved the desired combination of properties.

Shridharani does not teach all of the claimed elements of the present application. "Anticipation requires the disclosure in a single prior art reference of each element of the claim under consideration." *W. L. Gore & Assocs. v. Garlock, Inc.*, 721 F.2d 1540, 220 USPQ 303, 313 (Fed. Cir. 1983) (citing *Soundsciber Corp. v. United States*, 360 F.2d 954, 148 USPQ 298, 301 (Ct. Cl.), *adopted*, 149 USPQ 640 (Ct. Cl. 1966)) Further, the prior art reference must disclose each element of the claimed invention "arranged as in the

claim”. *Lindermann Maschinenfabrik GmbH v. American Hoist & Derrick Co.*, 730 F.2d 1452, 221 USPQ 481, 485 (Fed. Cir. 1984)(citing *Connell v. Sears, Roebuck & Co.*, 722 F.2d 1542, 220 USPQ 193 (Fed. Cir. 1983)). Shridharani does not teach a combination of an amide and a lactam gelling agent that will form a gel composition, such as those described in the present application and in addition, does not teach gel processing of the materials. Based on this argument, along with others such as that discussed above, Shridharani does not anticipate claims 1 and 13 of the present application because Shridharani is lacking and/or missing at least one specific feature or structural recitation found in the present application, and in claims 1 and 13. Claims 1 and 13 are therefore allowable as not being anticipated by Shridharani. Further, Shridharani does not anticipate claims 2, 4-12, 14, 16-24, 27 and 28 of the present application by virtue of their dependency on claims 1 and 13 respectively.

**ISSUE NO. 5 - §103(A) REJECTION OF CLAIMS 1-24, 27 AND 28 BASED ON BRITISH PATENT NO.:
2274109, AS APPLIED TO CLAIMS 1-10 AND 13-24, IN VIEW OF US 5223196**

Claims 1-24, 27 and 28 are rejected under 35 USC §103(a) as being unpatentable over British Patent No. 2274109 as applied to claims 1-10 and 13-24 in view of US 5223196 ("Shridharani"). The Applicant respectfully disagrees.

Claim 1 recites: "A pre-fiber gel composition, comprising: at least one amide-based polymer; and at least 15 weight percent of at least one lactam gelling agent, wherein the gel composition has sufficient viscosity and sufficient cohesiveness upon the mixing of the at least one amide-based polymer and the at least one lactam gelling agent that the composition can be spun into a fiber."

Claim 13 recites: "A method of producing a pre-fiber gel composition, comprising: providing at least one amide-based compound; providing at least 15 weight percent of at least one lactam gelling agent; and mixing the at least one amide-based polymer and the at least one lactam gelling agent such that there is sufficient viscosity and sufficient cohesiveness in the composition so that it can be spun into a fiber."

While the concept of gel compositions for forming fibers can be straightforward, successful implementation can be more difficult. The solvent-polymer system must achieve a gel that has sufficient solvation of the polymer molecules to manipulate the microstructure while still having sufficient melt strength to be processed into useful shapes.

Once the article has been made, the solvent is typically removed to bring the polymer to its full properties. Solvent removal and recovery presents numerous cost and equipment issues to extract and dry the polymer and then recycle or otherwise dispose of the spent solvents. Industrial hygiene and environmental issues further complicate implementation. It is understandable why this technology has been limited to very high value materials like ballistic fibers.

For example, there is no recognized solvent system for gel processing of polyamide 6 (also known as nylon-6 or poly-caprolactam). Standard solvents like formic acid yield a

solution far too low in viscosity for processing. Further, if nylon-6 gel processed products are to compete in applications other than high-cost ballistic fibers, a suitable solvent that is low-cost to implement is required. One candidate for gel processing nylon-6 products that has not been investigated is the epsilon-caprolactam monomer used to make nylon-6.

Caprolactam and nylon compounds have each been individually polymerized with the same compounds (i.e. caprolactam/caprolactam or nylon/nylon) by anionic polymerization in a twin-screw extruder and then tested for residual monomer content and thermal/mechanical properties. In both methods, however, the polymerization process used was not designed to and did not result in a pre-fiber gel composition that could be processed by any means (including extrusion), and there was no indication that the mechanical strength or thermal strength was improved by the single monomer/twin-screw extruder mixing process. (see Antec '93 Conference Proceedings, New Orleans, 9th-13th May 1993, Vol. 1, p. 470-473; and Antec '94 Conference Proceedings, San Francisco, CA, 1st-5th May 1994, Vol. 1, p. 116-22)

It was also known that caprolactam formed solutions with nylon-6, but these solutions took the form of residual, unpolymerized monomer found in the polymer. Typically nylon-6 resin is leached to remove this residual monomer. Deliberate addition of caprolactam for gel processing has not been previously considered. Gel processing and gel compositions are important because polymer parts have a practical limit in cross-section size due to the difficulty in forming such large cross-sections via melt processing. From a practical perspective, machines (extruders) to form polymer into shapes and sizes routinely available in metal simply do not exist. The other real limitation is that as melted polymer cools, significant shrinkage occurs. One can often find puckers on molded parts from shrink. To an extent, shrink can be compensated with clever mold design and tuning the molding process.

The formation of a pre-fiber gel composition and/or material allows for the control of the properties of the drawn fiber by allowing for more favorable orientation of the polymer molecules in the fiber. Controlling the molecule orientation can lead to increased tensile strength and overall fiber durability. Furthermore, at least part of the at least one gelling

agent (such as a lactam gelling agent) can be removed and recovered from the spun fiber once formed. In addition, any unpolymerized monomers can be subsequently polymerized after further processing to create properties in the spun fiber that are difficult or impossible to achieve with conventional spun polymers. This polymerization technique is described in commonly owned US Provisional Application entitled "Pre-Composite and Composite Materials, Methods of Manufacture and Uses Thereof" (Serial No. not yet assigned) that has been filed concurrently and is incorporated herein in its entirety by reference.

In T & N, a molding composition that contains nylon and magnesium hydroxide has caprolactam added to it to reduce the formation of surface defects. There is absolutely no teaching in T & N that the caprolactam addition to the mixture of nylon and magnesium hydroxide results in the formation of a gel composition. The Examiner contends in the Examiner's answer that "because the components and processing equipment of the patented invention are essentially the same as those of appellant claims, the formation of a gel is inherent". The Examiner is again overbroadening the applicability of the T&N patent to this application, and the Applicant respectfully requests that the Examiner review this response in view of T&N again in order to reopen prosecution.

In T&N, the applicants mix nylon, caprolactam, water, calcium stearate, glass fibers (as a reinforcement) and magnesium hydroxide. Note that in both examples, over 50% magnesium hydroxide is added – which is a significant chemical component, as compared to nylon and caprolactam. Also, it is instructive to note the presence of glass fibers in the mixture. These are not the same components as disclosed in the present application. In addition, despite the fact that the current independent claims uses "comprising" language, it is clear that the materials used in T&N will not form gel compositions – and therefore, they will not anticipate claim 1 and claim 13, which require that a gel composition be formed.

There are significant clues in T&N that show it is not disclosing gel compositions, such as those claimed in the present application. First, the components in T&N are heated to a temperature of 260°C while being screw extruded at a high RPM (250 RPM). In the current application, the materials and compositions produced in the present application are

designed to be produced at or below normal processing temperatures (see page 3 and Example 2) – an option that is not available in the T&N reference. The key reason why the T&N materials are “easy to extrude” is that they are being processed at high temperatures with high rotation rates of the extruder. That difference is what makes the current application special – gel compositions and fibers can be formed at lower temperatures with less effort.

Claim 1 and 13 states that “**the gel composition** has sufficient viscosity and sufficient cohesiveness **upon the mixing** of the at least one amide-based polymer and the at least one lactam gelling agent that the composition can be spun into a fiber”. In T&N, the material cannot be spun into a fiber until it is heated and extruded. In Example 2 of the current application, the inventors note “Furthermore, it was observed that extruder temperature could be dropped below conventional conditions for neat polymers, given that the gel compositions allowed for lower extruder pressures.” The Extruder temperature in T&N has not been dropped below that of conventional processes, again indicating that a gel composition has not been formed.

Second, the inclusion of about 10% of glass fibers for reinforcement purposes in the T&N reference is also troubling, given that the processing steps taken in the present application result in fibers and fiber products that are strengthened by the process and not by additional reinforcement additives.

Although the Examiner considers the fact that both references include the components of nylon and caprolactam in the final material – the Applicants believe it is unreasonable for the Examiner to consider them both implicitly identical given the large weight percent of other components in the T&N patent. Consider that the weight percent of all of the other components – other than the nylon and caprolactam – in the T&N patent outweigh the weight percent of nylon and caprolactam. Surely, the Examiner is considering that the large weight percent of these components must influence the chemical nature of the final material.

In Shridharani, a pigmented hexamethylene adipamide fiber is melt-spun from a

melt blend of a polymer and a colored pigment. The Background section of the present application clearly points out that melt processing is undesirable and that the compositions contemplated in the current application *do not need to be melt processed because of the formation of a gel composition*. The disclosure of the present application makes it very clear that formation of the gel composition and gel processing is an alternative to melt blending and melt spinning. Therefore, Shridharani provides the conventional method of processing these types of materials.

The combination of T&N with Shridharani does not cure the fact that neither reference renders the current claims as obvious and unpatentable. Neither reference discloses a gel composition or gel processing of the materials, and therefore, one of ordinary skill in the art of fiber processing and manufacturing will not read either reference alone or in combination and be motivated to produce the materials and fibers disclosed in the present application.

Formation of the gel composition is very important and central to the present application, because of all of the benefits of utilizing a gel composition mentioned herein. Fibers formed from these new gel compositions have superior strength and tensile properties because of the ability to spin the gel at high speeds, which suggests that nylon gel products can be manufactured with productivity comparable to melt processing. The excellent melt strength of the gels also allow the polymer to be highly shaped or drawn prior to solvent removal; or, only lightly processed, the caprolactam removed, and then post-processed to achieved the desired combination of properties.

Based on this argument, along with others such as that discussed above, GB 2274109 and Shridharani do not render as unpatentable 1 and 13 of the present application because neither reference, alone or in combination with the other reference, teaches, motivates or suggests to one of ordinary skill in the art to produce the gel compositions and materials disclosed in the present application. Claims 1 and 13 are therefore allowable as not being unpatentable over GB 2274109 in view of Shridharani. Further, neither reference, alone or in combination with the other reference, renders claims 2-12, 14-24, 27 and 28 of the present application unpatentable by virtue of their

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dependency on claims 1 and 13 respectively.

CONCLUSION

It should be clear from the current claims amendments that the Applicant is respectfully seeking to work with the Examiner in this case to move this matter forward to allowance, instead of wasting resources through the Appeal process. The undersigned Attorney of Record respectfully requests an interview with the Examiner to discuss this case, if this response does not put the claims in condition for allowance.

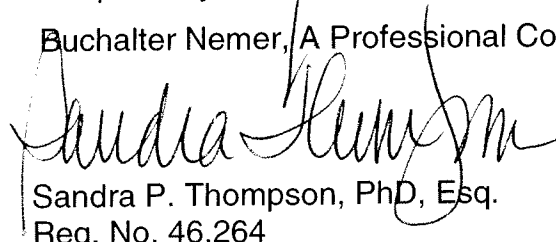
REQUEST FOR ALLOWANCE

Claims 1-8, 11-20, 23-30 are pending in this application, and the Applicant respectfully requests that the Examiner reconsider all of the claims in light of the arguments presented and allow all current and pending claims. **In addition, it appears that claim 26 is allowable if rewritten to incorporate the base claims. Please confirm this observation.**

Dated: September 30, 2009

By:

Respectfully submitted,
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